PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-074871
(43)Date of publication of application : 15.03.2002

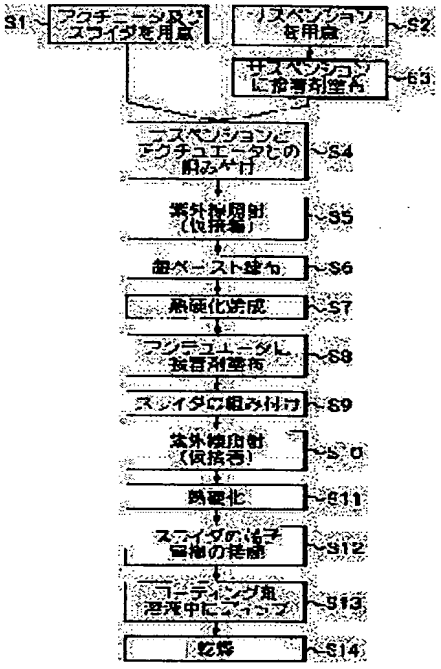
(51)Int.Cl. G11B 21/10
G11B 5/596
G11B 21/21

(21)Application number : 2000-262561
(22)Date of filing : 31.08.2000

(71)Applicant : TDK CORP
(72)Inventor : KASASHIMA TAMON
SHIRAISHI KAZUMASA

(54) HEAD GIMBALS ASSEMBLY EQUIPPED WITH ACTUATOR FOR FINE POSITIONING, DISK DEVICE EQUIPPED WITH HEAD GIMBALS ASSEMBLY, AND MANUFACTURING METHOD FOR HEAD GIMBALS ASSEMBLY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an HGA(head gimbals assembly) equipped with an actuator for fine positioning which prevents the grain drop of a piezoelectric material, does not impede the operation of the actuator, can be manufactured by a simplified process, and does not lower the strength of adhesion of the actuator, and to provide a disk device equipped with this HGA, and a method for manufacturing this HGA.
SOLUTION: A head slider having at least one head element is fixed on the actuator that uses a piezoelectric phenomena to perform the fine positioning of a head element. After fixing this actuator on a supporting mechanism to form the HGA, a coating film is deposited on the whole HGA by applying a low surface energy coating agent, for example, a fluorine system coating agent.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The head gimbal assembly which is equipped with the head slider which has at least one head component, the actuator using the piezoelectric phenomena which this head slider has fixed and perform minute positioning of said head component, and the support device for this actuator having fixed and supporting this actuator, and was equipped with the actuator for minute positioning characterized by covering the whole by the covering film by the low surface energy coating agent.
[Claim 2] The head gimbal assembly according to claim 1 characterized by having the displacement generating arm section to which said actuator connects the fixed part formed in one edge, the moving part formed in the other-end section, this fixed part, and moving part, for said support device having fixed to said fixed part in one field of said actuator, and said head slider having fixed to said moving part in the field of another side of said actuator.
[Claim 3] The head gimbal assembly according to claim 1 characterized by for said actuator having projected from the base which has fixed in said support device, and this base, equipping it with one pair of movable arm sections which can be displaced according to the driving signal, and ****(ing) said head slider between these movable arm sections.
[Claim 4] A head gimbal assembly given in any 1 term of claims 1-3 characterized by said low surface energy coating agent being a fluorine system coating agent.
[Claim 5] A head gimbal assembly given in any 1 term of claims 1-4 characterized by the thickness of said covering film being 1.8nm or less.
[Claim 6] The head gimbal assembly according to claim 5 characterized by the thickness of said covering film being 1.2nm or less.
[Claim 7] A head gimbal assembly given in any 1 term of claims 1-6 characterized by said head component being a thin film magnetic-head component.
[Claim 8] The disk unit characterized by equipping any 1 term of claims 1-7 with at least one head gimbal assembly of a publication.
[Claim 9] The manufacture approach of the head gimbal assembly characterized by forming the covering film by the low surface energy coating agent in this whole head gimbal assembly after fixing in a support device through the actuator using the piezoelectric phenomena which perform minute positioning of this head component for the head slider which has at least one head component and forming a head gimbal assembly.
[Claim 10] It has the displacement generating arm section which connects the fixed part formed in one edge, the moving part formed in the other-end section, this fixed part, and moving part. The actuator using the piezoelectric phenomena which perform minute positioning of a head component is prepared. After fixing to said moving part of said actuator which fixed said fixed part of this actuator in the support device, and fixed the head slider which has at least one head component in this support device and forming a head gimbal assembly, The manufacture approach of the head gimbal assembly characterized by forming the covering film by the low surface energy coating agent in this whole head gimbal assembly.
[Claim 11] The actuator for head component minute positioning equipped with one pair of movable arm sections which can be displaced according to the driving signal is prepared. The head slider which has at least one head component between said movable arm sections of this actuator is ****(ed). The manufacture approach of the head gimbal assembly characterized by forming the covering film by the low surface energy coating agent in this whole head gimbal assembly after fixing said actuator which attached this head slider in a support device and forming a head gimbal assembly.
[Claim 12] The manufacture approach given in any 1 term of claims 9-11 characterized by for formation of said covering film drying said head gimbal assembly after being immersed in a low surface energy coating agent solution, and performing it.
[Claim 13] The manufacture approach given in any 1 term of claims 9-12 characterized by said low surface energy coating agent being a fluorine system coating agent.
[Claim 14] The manufacture approach given in any 1 term of claims 9-13 characterized by setting thickness of said covering film to 1.8nm or less.
[Claim 15] The manufacture approach according to claim 14 characterized by setting thickness of said covering film to 1.2nm or less.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the head gimbal assembly (HGA) equipped with the actuator for minute positioning of head components, such as a thin film magnetic-head component or an optical head component, the disk unit equipped with this HGA, and this manufacture approach of HGA.
[0002]
[Description of the Prior Art] In a magnetic disk drive, the magnetic-head slider attached in the point of the suspension of HGA is surfaced from the front face of the rotating magnetic disk, and record to a magnetic disk and/or playback from a magnetic disk are performed by the thin film magnetic-head component carried in this magnetic-head slider in that condition.
[0003] large-capacity-izing of recent years and a magnetic disk drive, and the formation of high density record — following — the densification of a disk radial (truck cross direction) consistency — progressing — **** — the former — the time — a voice coil motor (Following VCM is called) — depending — control — **** — the magnetic head — it is becoming difficult to double a location correctly.
[0004] It is the technique in which the actuator performs detailed precision positioning which being proposed as one of the means which realizes precision positioning of the magnetic head carries another actuator style in a magnetic-head slider side further, and it cannot follow by VCM from the conventional VCM (for example, refer to JP,6-259905,A, JP,6-309822,A, and JP,8-180623,A).
[0005]
[Problem(s) to be Solved by the Invention] When this kind using a piezoelectric device of actuator is used, there is a problem (it degrains) of which the particle of a piezoelectric device drops out. That is, since the piezoelectric material itself is a brittle ingredient, even if it is in an anticipated-use condition, grain boundaries, such as a crystal, exfoliate by prolonged actuation, and it becomes easy to generate degraining highly [the probability for the own chip and own crack of a component to occur]. Any degraining is not allowed in this kind arranged on a magnetic disk of actuator.
[0006] It is difficult for such a piezoelectric material to change the own property of a material so that degraining may decrease. For this reason, these people have already proposed the technique of aiming at degraining prevention, by performing coating on the surface of an actuator (Japanese Patent Application No. No. 296597 [11 to]).
[0007] Generally, in HGA equipped with the actuator, in order not to check a motion of an actuator, it is necessary to keep and assemble a gap between an actuator and a suspension between a magnetic-head slider and an actuator depending on the case. However, if coating is performed on the surface of an actuator, such a gap is lost, friction will arise between a magnetic-head slider and an actuator and/or between an actuator and a suspension, the stroke (variation rate) of an actuator will fall, and a motion of a slider will be checked.
[0008] Furthermore, if coating is performed, it will become difficult to maintain the bond strength in the coating side, and degradation on the strength will surely arise.
[0009] Therefore, this invention cancels the trouble which the conventional technique mentioned above, and that purpose is in offering HGA equipped with the actuator for minute positioning which can prevent degraining certainly, the disk unit equipped with this HGA, and this manufacture approach of HGA, also when piezoelectric material is used.
[0010] Other purposes of this invention are to offer HGA equipped with the actuator for minute positioning which can moreover simplify a production process, the disk unit equipped with this HGA, and this manufacture approach of HGA, without checking the variation rate of an actuator.
[0011] The purpose of further others of this invention is to offer HGA equipped with the actuator for minute positioning without the fall of the bond strength of an actuator, the disk unit equipped with this HGA, and this manufacture approach of HGA.
[0012]
[Means for Solving the Problem] The head slider which has at least one head component according to this invention, The actuator using the piezoelectric phenomena which this head slider has fixed and perform minute positioning of a head component, It has the support device for this actuator having fixed and supporting an actuator. The disk unit equipped with HGA and at least one HGA equipped with the actuator for minute positioning covered by the covering film by the low surface energy coating agent whose whole is for example, a fluorine system coating agent is offered.
[0013] After fixing in a support device through the actuator using the piezoelectric phenomena which perform

minute positioning of a head component for the head slider which has at least one head component and forming HGA according to this invention furthermore, the manufacture approach of HGA which forms in this whole HGA the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent is offered.

[0014] Furthermore, according to this invention, it has the displacement generating arm section which connects the fixed part formed in one edge, the moving part formed in the other-end section, these fixed parts, and moving part. The actuator using the piezoelectric phenomena which perform minute positioning of a head component is prepared. After fixing to the moving part of the actuator which fixed the fixed part of this actuator in the support device, and fixed the head slider which has at least one head component in the support device and forming HGA, The manufacture approach of HGA which forms in this whole HGA the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent is offered.

[0015] Furthermore, according to this invention, the actuator for head component minute positioning equipped with one pair of movable arm sections which can be displaced according to the driving signal is prepared. The head slider which has at least one head component between the movable arm sections of this actuator is ****(ed). After fixing the actuator which attached the head slider in a support device and forming HGA, the manufacture approach of HGA which forms in this whole HGA the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent is offered.

[0016] Since the whole HGA is covered by the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent and all the piezoelectric-material parts of an actuator will also be covered, degraining becomes that there is nothing. Since a low surface energy coating agent has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.

[0017] Moreover, since it is covered to the electrode terminal area of not only piezoelectric material but an actuator and a head slider, improvement in dependability of connection can also be aimed at. In addition, since the surfacing side (ABS) of a head slider is also covered by coincidence, contamination adhesion in ABS can also be prevented.

[0018] Furthermore, since the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent is formed in this whole HGA after forming HGA (i.e., since it has coated after adhesion), bond strength does not fall.

[0019] It is desirable that have the displacement generating arm section to which an actuator connects the fixed part formed in one edge, the moving part formed in the other-end section, these fixed parts, and moving part, the support device has fixed to the fixed part in one field of an actuator, and the head slider has fixed to the moving part in the field of another side of an actuator.

[0020] The actuator has projected from the base which has fixed in the support device, and the base, and is equipped with one pair of movable arm sections which can be displaced according to the driving signal, and it is also desirable that the head slider is ****(ed) between the movable arm sections.

[0021] It is desirable that the thickness of the covering film is 1.8nm or less, and it is more desirable that it is 1.2nm or less. by boiling the thickness of the covering film to this extent, and controlling it, it is lost that the stroke (variation rate) of an actuator does not fall and a motion of a head slider is checked.

[0022] It is desirable that a head component is also a thin film magnetic-head component.

[0023] It is desirable that formation of the covering film dries HGA after being immersed in the low surface energy coating agent solution which is for example, a fluorine system coating agent, and it is performed. Thus, since the covering film is formed in the whole HGA by immersion and thin layer coating can be performed, without filling the gap between each part material of HGA, actuation of an actuator is not checked. And since coating of HGA can be performed only in immersion, a production process can be simplified sharply.

[0024]

[Embodiment of the Invention] Drawing 1 is the perspective view showing the configuration of the important section of a magnetic disk drive roughly as 1 operation gestalt of this invention, drawing 2 is the top view which looked at the whole head gimbal assembly (HGA) in the operation gestalt of drawing 1 from the slider side, and drawing 3 is the decomposition perspective view showing the installation structure to FUREKUSHA of the actuator in the operation gestalt of drawing 1 , and a magnetic-head slider. In addition, this operation gestalt is the case where what is called piggyback structure is used as an actuator.

[0025] In drawing 1 , two or more magnetic disks with which 10 rotates the surroundings of a shaft 11, and 12 show the assembly carriage equipment for positioning a magnetic-head slider on a truck, respectively. assembly carriage equipment 12 — a core [shaft / 13] — carrying out — an angle — it mainly consists of rockable carriage 14 and a main actuator 15 which carries out the angle rocking drive of this carriage 14 and which consists of a voice coil motor (VCM), for example.

[0026] The base of two or more drive arms 16 by which the stack was carried out is attached in the direction of a shaft 13 at carriage 14, and HGA17 has fixed to the point of each drive arm 16. Each HGA17 is formed in the point of the drive arm 16 so that the magnetic-head slider formed in the point may counter to the front face of each magnetic disk 10.

[0027] As shown in drawing 2 and drawing 3 , HGA attaches the actuator 22 for performing precision positioning of a magnetic-head component to the point of a suspension 20, fixes the slider 21 which has a magnetic-head component in the actuator 22, and is constituted.

[0028] The main actuator 15 shown in drawing 1 is formed in order to carry out the variation rate of the drive arm

16 which attached HGA17 and to move the whole assembly, and with such a main actuator 15, the actuator 22 is formed in order to make possible the detailed variation rate which cannot be driven.
[0029] The suspension 20 mainly consists of FUREKUSHA 26 which has the elasticity which supports a slider 21 through an actuator 22, a load beam 23 with which support fixing of FUREKUSHA 26 is carried out, and this also has elasticity, and a base plate 27 prepared in the base of the load beam 23, as shown in drawing 2 and drawing 3 .
[0030] FUREKUSHA 26 has soft tongue 26a pressed by the dimple prepared in the load beam 23 at one edge, and has the elasticity which supports a slider 21 flexibly through an actuator 22 by this tongue 26a. Like this operation gestalt, the rigidity of FUREKUSHA 26 is lower than the rigidity of the load beam 23 in the suspension of 3 piece structures where FUREKUSHA 26 and the load beam 23 became independent which are components.
[0031] FUREKUSHA 26 is constituted from this operation gestalt by the stainless steel plate (for example, SUS304TA) with a thickness of about 25 micrometers.
[0032] The load beam 23 consists of stainless steel plates which have the elasticity of about 60-65-micrometer thickness of the configuration to which width of face becomes narrow towards a tip, and is supporting FUREKUSHA 26 over the overall length. However, fixing with FUREKUSHA 26 and the load beam 23 is made by pinpoint fixing with two or more welding points.
[0033] The base plate 27 consists of stainless steel or iron, and has fixed by welding to the base of the load beam 23. By attaching this base plate 27 and fixing by section 27a, installation to the drive arm 16 (drawing 1) of a suspension 20 is performed. In addition, FUREKUSHA 26 and the load beam 23 are not formed separately, but it is good also as a suspension of 2 piece structures of a base plate and a FUREKUSHA-load beam.
[0034] two or more leads depended on a laminating thin film pattern on FUREKUSHA 26 — the flexible wiring member 28 containing a conductor is formed. That is, the wiring member 28 is formed on the metallic thin plate like the FUREKUSHI bull printed circuit (Flexible Print Circuit, FPC) by the same well-known patterning approach as creating a printed circuit board. For example, it is formed by carrying out the laminating of the 2nd insulating ingredient layer by resin ingredients, such as polyimide with an insulating ingredient layer [by resin ingredients, such as polyimide with a thickness of about 5 micrometers, / 1st], a Cu layer (lead conductor layer) of with a thickness of about 4 micrometers patternized, and a thickness of about 5 micrometers, one by one from a FUREKUSHA 26 side in this sequence. However, as for the part of the connection pad for connecting with a magnetic-head component and an external circuit, laminating formation of the Au layer is carried out on Cu layer, and the insulating ingredient layer is not formed on it.
[0035] two one side and the both sides by which this wiring member 28 is connected to a magnetic-head component in this operation gestalt — the lead of a total of four — 1st wiring member 28a containing a conductor, and two one side and the both sides which are connected to an actuator 22 — the lead of a total of four — it consists of the 2nd wiring member 28b containing a conductor.
[0036] the lead of 1st wiring member 28a — the end of a conductor is connected to the connection pad 29 for magnetic-head components prepared in the point of FUREKUSHA 26. The connection pad 29 is connected to the terminal electrode of the magnetic-head slider 21 by golden bonding, wirebonding, or stitch bonding. the lead of 1st wiring member 28a — the other end of a conductor is connected to the connection pad 30 for external circuits for connecting with an external circuit.
[0037] the lead of 2nd wiring member 28b — the end of a conductor is connected to the connection pad for actuators (with no illustration) formed in tongue 26a of FUREKUSHA 26, and this connection pad is connected to the terminal electrode of an actuator 22. the lead of 2nd wiring member 28b — the other end of a conductor is connected to the connection pad 30 for external circuits for connecting with an external circuit.
[0038] An actuator 22 has fixed part 22a and moving-part 22b, and has further the two rod-like displacement generating arm sections 22c and 22d which connect these. Piezo-electricity and at least one layer of electrostriction ingredient layers in which an electrode layer exists are prepared in both sides at the displacement generating arm sections 22c and 22d, and it has the composition of generating telescopic motion, by impressing an electrical potential difference to an electrode layer. Piezo-electricity and an electrostriction ingredient layer consist of piezo-electricity and an electrostriction ingredient expanded and contracted according to an inverse piezoelectric effect or an electrostrictive effect. Three terminal electrodes connected to the above-mentioned electrode layer are formed in fixed part 22a.
[0039] As shown in drawing 3 , the top face in fixed part 22a of an actuator 22 has pasted tongue 26a of FUREKUSHA 26 with adhesives. Moving-part 22b of an actuator 22 has fixed, when a root face pastes predetermined section 22a by the side of the back end of the magnetic-head slider 21 (formation one end of magnetic-head component 21b) with adhesives.
[0040] Thus, a displacement generating arm sections [22c and 22d] end is connected with FUREKUSHA 26 through fixed part 22a, and the displacement generating arm sections [22c and 22d] other end is connected with the slider 21 through moving-part 22b. Therefore, a slider 21 displaces by telescopic motion of the displacement generating arm sections 22c and 22d, and it displaces to an arc so that a magnetic-head component may intersect the recording track of a magnetic disk.
[0041] When the piezo-electricity and electrostriction ingredient layer in the displacement generating arm sections 22c and 22d consist of so-called piezoelectric material, such as PZT, polarization processing for the improvement in the displacement engine performance is usually performed to this piezo-electricity and electrostriction ingredient layer. The direction of polarization by this polarization processing is the thickness direction of an actuator 22. When the sense of the electric field when impressing an electrical potential difference to an electrode layer is in

agreement with the direction of polarization, it elongates in the thickness direction (piezo-electric longitudinal effect), and the piezo-electricity and electrostriction ingredient layer between two electrodes are contracted by the field inboard (piezo-electric transversal effect). On the other hand, when the sense of electric field is contrary to the direction of polarization, it contracts in the thickness direction (piezo-electric longitudinal effect), and piezo-electricity and an electrostriction ingredient layer are elongated by the field inboard (piezo-electric transversal effect). and one variation rate — the variation rate of the generating arm section and another side — if the electrical potential difference which makes the generating arm section produce contraction is impressed by turns — one variation rate — the die length of the generating arm section, and the variation rate of another side — a ratio with the die length of the generating arm section — changing — this — both — a variation rate — the generating arm section bends in this direction in the field of an actuator 22. By this bending, moving-part 22b will rock in the direction of the arrow head 31 of drawing 3 to fixed part 22a by making the location at the time of no electrical-potential-difference impressing into a center. This rocking is a variation rate to which moving-part 22b draws an arc-shaped locus in the direction which intersects perpendicularly mostly to the displacement generating arm sections [22c and 22d] flexible direction, and the rocking direction exists in the field of an actuator. Therefore, a magnetic-head component will also draw and rock an arc-shaped locus. Since an electrical potential difference and polarization have the the same sense at this time, there is no fear of polarization attenuation and it is desirable. In addition, even if the electrical potential difference impressed to both the displacement generating arm section by turns expands the displacement generating arm section, the same rocking arises.

[0042] As an actuator 22, an electrical potential difference which a reverse variation rate produces mutually may be impressed to both the displacement generating arm section at coincidence. That is, when another side contracts in them when one side develops in one displacement generating arm section and the displacement generating arm section of another side, and one side contracts in them, an alternation electrical potential difference which another side elongates may be impressed to coincidence. Rocking of moving-part 22b at this time makes a center the location at the time of no electrical-potential-difference impressing. In this case, the amplitude of rocking when making driver voltage the same becomes the twice [about] in the case of impressing an electrical potential difference by turns. However, in this case, by one rocking side, the displacement generating arm section is made elongated and the driver voltage at this time becomes contrary to the sense of polarization. For this reason, when applied voltage is high, in performing electrical-potential-difference impression continuously, there is a possibility that polarization of piezo-electricity and an electrostriction ingredient may decline. Therefore, it is made for the sense of driver voltage not to become the sense and reverse of polarization by applying fixed direct-current bias voltage to polarization and the same direction, and making into driver voltage what superimposed said alternation electrical potential difference on this bias voltage. Rocking in this case makes the location when impressing only bias voltage a center.

[0043] In addition, piezo-electricity and an electrostriction ingredient mean the ingredient expanded and contracted according to an inverse piezoelectric effect or an electrostrictive effect. Although piezo-electricity and an electrostriction ingredient may be anything as long as it is ingredients applicable to the displacement generating arm section of an actuator which was mentioned above, its ceramic piezo-electricity and electrostriction ingredients, such as PZT [Pb(Zr, Ti) O3], PT (PbTiO3), PLZT [(Pb, La) (Zr, Ti) O3], and barium titanate (BaTiO3), are usually desirable from rigidity being high.

[0044] Although the important point is not shown in drawing in this operation gestalt, the whole HGA is covered by the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent. As a fluorine system coating agent, Fluorad FC-722 of Sumitomo 3M, Inc. are used, for example.

[0045] Thus, since all the PZT parts of an actuator 22 will also be covered by covering the whole HGA by the covering film, degraining becomes that there is nothing. Since the fluorine system coating agent of FC-722 grade has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.

[0046] Moreover, since it is covered to the electrode terminal area of not only PZT but the actuator 22 and the head slider 21, improvement in dependability of connection can also be aimed at. In addition, since ABS of the head slider 21 is also covered by coincidence, contamination adhesion in ABS can also be prevented.

[0047] The structure of be [it / what is limited to the structure described above] of the suspension in HGA of this invention is clear. In addition, although not illustrated, you may equip with IC chip for a head drive in the middle of a suspension 20.

[0048] Drawing 4 is a flow chart for explaining 1 manufacture process of HGA in this operation gestalt.

[0049] First, the actuator 22 and the magnetic-head slider 21 like the above-mentioned are prepared (step S1).

[0050] Adhesives are applied to jointing of tongue 26a of FUREKUSHA 26 of the suspension 20 (step S2) prepared for the suspension side (step S3).

[0051] Subsequently, attachment by the actuator 22 and the suspension is performed (step S4), after that, ultraviolet rays are irradiated, adhesives are stiffened to some extent, and temporary adhesion is performed (step S5).

[0052] Subsequently, while applying and (step S6) heating a silver paste into the part which corresponds the terminal electrode of an actuator 22 to the connection pad formed in tongue 26a of FUREKUSHA 26 that it should connect and calcinating a silver paste, heat curing of the adhesives is carried out completely (step S7).

[0053] Then, adhesives are applied on the root face of the actuator 22 in actuator-suspension ashy which carried out in this way and was assembled (step S8).

[0054] Subsequently, on these actuator-suspension ashy, the magnetic-head slider 21 is attached, HGA is formed (step S9), after that, after irradiating ultraviolet rays, stiffening adhesives to some extent and performing temporary adhesion (step S10), further, it heats and heat curing of the adhesives is carried out completely (step S11).
[0055] Subsequently, processing which connects the terminal electrode of the magnetic-head slider 21 to the connection pad 29 in which it was prepared by the point of FUREKUSHA 26 is performed (step S12).
[0056] Then, HGA which carried out in this way and was assembled is dipped in the solution of Fluorad FC-722 of for example, Sumitomo 3M, Inc. which is every round head and a fluorine system coating agent (step S13). Although it is a mere example, specifically, it is immersed into the solution which dissolved and obtained FC-722 (2%) by PF5060 (98%) of Sumitomo 3M, Inc. which is a solvent (DIP).
[0057] Subsequently, HGA is pulled up and dried from this solution (step S14). This desiccation is made by putting in HGA in oven, for example, performing 120 degrees C and heat curing for about 30 minutes. Ultraviolet rays or infrared radiation may be irradiated and may carry out heat curing.
[0058] Since the whole HGA is covered by the covering film and all the PZT parts of an actuator will also be covered by this, degraining becomes that there is nothing. Since the fluorine system coating agent of FC-722 grade has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.
[0059] Moreover, since it is covered to the electrode terminal area of not only PZT but the actuator 22 and the head slider 21, improvement in dependability of connection can also be aimed at. In addition, since ABS of the head slider 21 is also covered by coincidence, contamination adhesion in ABS can also be prevented. Furthermore, since the covering film by the fluorine system coating agent is formed in this whole HGA after forming HGA through processes, such as adhesion, bond strength does not fall. And since coating of HGA can be performed only in a DIP, a production process can be simplified sharply.
[0060] Although it is controllable, if it becomes not much thick, a motion of an actuator 22 will be checked by the concentration of the solution at the time of a DIP, the rate (generally, if a raising rate is quick, thickness will become thick, and it will become thin if late) when dipping and pulling up HGA from a DIP tub, DIP temperature, etc., and, as for the thickness of the wrap covering film, a stroke (variation rate) will fall the whole HGA with them. Drawing 5 is drawing showing the fall property of a stroke over the thickness of the covering film. As shown in this drawing, without that it is 1.8nm or less filling the gap between each part material of HGA, from the point that thin layer coating can be performed, the thickness of the covering film is desirable and it is more desirable that it is 1.2nm or less.
[0061] In addition, without being limited to a fluorine system coating agent solution, as long as the solution into which HGA is made to dip is a low surface energy coating agent solution, it may be what kind of thing.
[0062] Drawing 6 is a perspective view showing the whole HGA in other operation gestalten of this invention, and drawing 7 and drawing 8 are the perspective views which looked at the point of HGA in the operation gestalt of drawing 6 from a mutually different direction. In addition, this operation gestalt is the case where a slider **** type thing is used, as an actuator.
[0063] As shown in drawing 6 - drawing 8 , HGA in this operation gestalt fixes the actuator 62 for performing precision positioning which is pinching the side face of the magnetic-head slider 61 in which it has a magnetic-head component to the point of a suspension 60, and is constituted.
[0064] The main actuator 15 shown in drawing 1 is formed in order to carry out the variation rate of the drive arm 16 which attached HGA17 and to move the whole assembly, and with such a main actuator 15, this actuator 62 is formed in order to make possible the detailed variation rate which cannot be driven.
[0065] As a suspension 60 is shown in drawing 6 - drawing 8 , the 1st and the 2nd load beam 63 and 64, The hinge 65 which has the elasticity which connects mutually these [1st] and the 2nd load beam 63 and 64, It mainly consists of FUREKUSHA 66 which has the elasticity by which fixing support was carried out on the 2nd load beam 64 and a hinge 65, and a circular base plate 67 prepared at installation section 63a of the 1st load beam 63.
[0066] FUREKUSHA 66 has soft tongue 66a pressed by the dimple (with no illustration) prepared in the 2nd load beam 64 at one edge, and base 62a of an actuator 62 has fixed through insulating-layer 66b by polyimide etc. on this tongue 66a. This FUREKUSHA 66 has the elasticity which supports the magnetic-head slider 61 flexibly through an actuator 62 by this tongue 66a. FUREKUSHA 66 is constituted from this operation gestalt by the stainless steel plate (for example, SUS304TA) with a thickness of about 20 micrometers. In addition, fixing with FUREKUSHA 66, the 2nd load beam 64, and a hinge 65 is made by pinpoint fixing with two or more welding points.
[0067] The hinge 65 has the elasticity for giving the force of suppressing a slider 61 in the direction of a magnetic disk through an actuator 62 with the 2nd load beam 64. This hinge 65 is constituted from this operation gestalt by the stainless steel plate with a thickness of about 40 micrometers.
[0068] With this operation gestalt, the 1st load beam 63 consists of stainless steel plates of about 100-micrometer thickness, and it goes across a hinge 65 all over the, and it is supporting it. However, fixing with the load beam 63 and a hinge 65 is made by pinpoint fixing with two or more welding points. Moreover, with this operation gestalt, the 2nd load beam 64 also consists of stainless steel plates of about 100-micrometer thickness, and has fixed in the edge to the hinge 65. However, fixing with the load beam 64 and a hinge 65 is also made by pinpoint fixing with two or more welding points. In addition, lift tab 64a for separating HGA from the magnetic-disk front face at the time of un-operating is prepared at the tip of this 2nd load beam 64.
[0069] With this operation gestalt, the base plate 67 consists of the stainless steel or iron of about 150-micrometer thickness, and has fixed by welding to installation section 63a of the base of the 1st load beam 63. This base plate

67 is attached in the drive arm 16 (drawing 1).
[0070] two or more leads depended on a laminating thin film pattern on FUREKUSHA 66 — the flexible wiring member 68 containing a conductor is formed or laid. The wiring member 68 is formed on the metallic thin plate like FPC by the same well-known patterning approach as creating a printed circuit board. This wiring member 68 is formed by carrying out the laminating of the 2nd insulating ingredient layer by resin ingredients, such as polyimide with an insulating ingredient layer [by resin ingredients, such as polyimide with a thickness of about 5 micrometers, / 1st], a Cu layer (lead conductor layer) of with a thickness of about 4 micrometers patternized, and a thickness of about 5 micrometers, one by one from a FUREKUSHA 66 side in this sequence. However, as for the part of the connection pad for connecting with a magnetic-head component, an actuator, and an external circuit, laminating formation of the Au layer is carried out on Cu layer, and the insulating ingredient layer is not formed on it.

[0071] two one side and the both sides by which this wiring member 68 is connected to a magnetic-head component in this operation gestalt — the lead of a total of four — 1st wiring member 68a containing a conductor, and one one side and the both sides which are connected to an actuator 62 — the lead of a total of two — it consists of the 2nd wiring member 68b containing a conductor.
[0072] the lead of 1st wiring member 68a — the end of a conductor is connected to the connection pad 69 for magnetic-head components prepared on separation section 66c which is separated from this FUREKUSHA 66 and can carry out a free movement in the point of FUREKUSHA 66. The connection pad 69 is connected to terminal electrode 61a of the magnetic-head slider 61 by golden bonding, wirebonding, or stitch bonding. the lead of 1st wiring member 68a — the other end of a conductor is connected to the connection pad 70 for external circuits for connecting with an external circuit.
[0073] the lead of 2nd wiring member 68b — the end of a conductor is connected to the connection pad 71 for actuators formed on insulating-layer 66b of tongue 66a of FUREKUSHA 66, and this connection pad 71 is connected to A channels and the B channel signal terminal electrodes 62b and 62c which were prepared in base 62a of an actuator 62, respectively. the lead of 2nd wiring member 68b — the other end of a conductor is connected to the connection pad 70 for external circuits for connecting with an external circuit.
[0074] The structure of be [it / what is limited to the structure described above] of the suspension in HGA of this invention is clear. In addition, although not illustrated, you may equip with IC chip for a head drive in the middle of a suspension 60.
[0075] Drawing 9 is the top view showing the structure of the actuator in this operation gestalt.
[0076] As shown in this drawing, one pair of movable arm sections 91 and 92 are perpendicularly extended from the both ends of the base 90 (62a) where the flat-surface configuration fixes an actuator 62 to a suspension by having become abbreviation KO character-like. The slider fixing sections 93 and 94 which fix on the side face of the magnetic-head slider 61 are formed in the point of the movable arm sections 91 and 92, respectively. Spacing between the slider fixing section 93 and 94 is set up so that it may become a little smaller than the width of face of the magnetic-head slider which should ****. The thickness of an actuator 62 is set below to the thickness of the magnetic-head slider which should **** so that thickness of HGA may not be increased by actuator mounting. Conversely, if it says, the reinforcement of the actuator itself can be raised by enlarging to the thickness of the magnetic-head slider which should **** thickness of an actuator 62, without increasing the thickness of HGA.
[0077] The slider fixing sections 93 and 94 are projected in the magnetic-head slider 61 direction, and only this part fixes with the side face of the magnetic-head slider 61, and they are made by this as [serve as / the remaining part between a magnetic-head slider side face and the movable arm sections 91 and 92 / an opening].
[0078] The movable arm sections 91 and 92 consist of piezoelectric devices 91b and 92b formed in the side face of the arm members 91a and 92a and these arm members 91a and 92a, respectively.
[0079] The arm members 91a and 92a are formed in the base 90 list with the ceramic sintered compact 2 which has elasticity, for example, ZrO, in one. Thus, it is high, i.e., the shock resistance of the actuator itself improves the principal part of an actuator by [which is rigidity] considering as the ceramic sintered compact of strong ZrO2 grade to bending.
[0080] Each of piezoelectric devices 91b and 92b has multilayer structure to which the laminating of the piezo-electricity and electrostriction ingredient layer and signal-electrode layer which are expanded and contracted according to an inverse piezoelectric effect or an electrostrictive effect, and the grand electrode layer was carried out by turns. The signal-electrode layer is connected to A channels shown in drawing 7 and drawing 8 , B channel signal terminal electrode 62b, or 62c, and the grand electrode layer is connected to 62d of grand terminals, and 62e.
[0081] Piezo-electricity and an electrostriction ingredient layer consist of so-called piezoelectric material, such as PZT, and polarization processing for the improvement in the displacement engine performance is usually performed. The direction of polarization by this polarization processing is the direction of a laminating of a piezoelectric device. When the sense of the electric field when impressing an electrical potential difference to an electrode layer is in agreement with the direction of polarization, it elongates in the thickness direction (piezo-electric longitudinal effect), and the piezo-electricity and electrostriction ingredient layer between two electrodes are contracted by the field inboard (piezo-electric transversal effect). On the other hand, when the sense of electric field is contrary to the direction of polarization, it contracts in the thickness direction (piezo-electric longitudinal effect), and piezo-electricity and an electrostriction ingredient layer are elongated by the field inboard (piezo-electric transversal effect).
[0082] If the electrical potential difference which makes piezoelectric devices 91b and 92b produce contraction or

expanding is impressed, each piezoelectric-device part contracts or develops each time, by this, each of the movable arm sections 91 and 92 will bend in the shape of S character, and the point will rock it linearly in a longitudinal direction. Consequently, the magnetic-head slider 61 is similarly rocked linearly in a longitudinal direction. Thus, since it is not angle rocking but straight-line rocking, high positioning of precision is attained from that of a magnetic-head component.

[0083] An electrical potential difference which a reverse variation rate produces mutually may be impressed to both piezoelectric devices at coincidence. That is, when another side contracts to them when one side develops to one piezoelectric device and the piezoelectric device of another side, and one side contracts to them, an alternation electrical potential difference which another side elongates may be impressed to coincidence. Rocking of the movable arm section at this time makes a center the location at the time of no electrical-potential-difference impressing. In this case, the amplitude of rocking when making driver voltage the same becomes the twice [about] in the case of impressing an electrical potential difference by turns. However, in this case, by one rocking side, a piezoelectric device is made elongated and the driver voltage at this time becomes contrary to the sense of polarization. For this reason, when applied voltage is high, in performing electrical-potential-difference impression continuously, there is a possibility that polarization of piezo-electricity and an electrostriction ingredient may decline. Therefore, it is made for the sense of driver voltage not to become the sense and reverse of polarization by applying fixed direct-current bias voltage to polarization and the same direction, and making into driver voltage what superimposed the above-mentioned alternation electrical potential difference on this bias voltage. Rocking in this case makes the location when impressing only bias voltage a center.

[0084] In addition, piezo-electricity and an electrostriction ingredient mean the ingredient expanded and contracted according to an inverse piezoelectric effect or an electrostrictive effect. Although piezo-electricity and an electrostriction ingredient may be anything as long as it is ingredients applicable to the movable arm section of an actuator which was mentioned above, its ceramic piezo-electricity and electrostriction ingredients, such as PZT [Pb (Zr, Ti) O3], PT (PbTiO3), PLZT [(Pb, La) (Zr, Ti) O3], and barium titanate (BaTiO3), are usually desirable from rigidity being high.

[0085] Although the important point is not shown in drawing in this operation gestalt, the whole HGA is covered by the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent. As a fluorine system coating agent, Fluorad FC-722 of Sumitomo 3M, Inc. are used, for example.

[0086] Thus, since all the PZT parts of an actuator 62 will also be covered by covering the whole HGA by the covering film, degraining becomes that there is nothing. Since the fluorine system coating agent of FC-722 grade has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.

[0087] Moreover, since it is covered to the electrode terminal area of not only PZT but the actuator 62 and the head slider 61, improvement in dependability of connection can also be aimed at. In addition, since ABS of the head slider 61 is also covered by coincidence, contamination adhesion in ABS can also be prevented.

[0088] The structure of be [it / what is limited to the structure described above] of the suspension in HGA of this invention is clear. In addition, although not illustrated, you may equip with IC chip for a head drive in the middle of a suspension 60.

[0089] Drawing 10 is a flow chart for explaining 1 manufacture process of HGA in this operation gestalt.

[0090] First, the actuator 62 like the above-mentioned is prepared (step S101).

[0091] Adhesives are applied to the both-sides side of the magnetic-head slider 61 (step S102) prepared for the magnetic-head slider 61 side (step S103).

[0092] Subsequently, this magnetic-head slider 61 is inserted between the movable arm section 91 of the actuator 62 currently similarly laid on the plate, and 92 (step S104), after that, ultraviolet rays are irradiated, adhesives are stiffened to some extent, and temporary adhesion is performed (step S105). In addition, if it sets up so that spacing between the slider fixing section 93 in the movable arm sections 91 and 92 of an actuator 62 and 94 may become a little smaller than the width of face of the magnetic-head slider 61, temporary immobilization of the magnetic-head slider 61 will be carried out by the retention span of the movable arm sections 91 and 92, without using a holder etc.

[0093] Subsequently, it heats and heat curing of the adhesives is carried out completely (step S106). Thereby, slider-actuator ashy which is the complex of the magnetic-head slider 61 and an actuator 62 is formed.

[0094] On the other hand, a suspension which was mentioned above is prepared (step S107), adhesives are applied on separation section 66c of FUREKUSHA 66, respectively the insulating-layer 66b top in tongue 66a of the FUREKUSHA 66 (step S108), and adhesion immobilization of slider-actuator ashy is carried out on a suspension. Thereby, attachment by the slider-actuator ashy suspension is performed and HGA is formed (step S109).

[0095] Subsequently, after irradiating ultraviolet rays, stiffening adhesives to some extent and performing temporary adhesion (step S110), further, it heats and heat curing of the adhesives is carried out completely (step S111).

[0096] Subsequently, processing which connects the terminal electrode of the magnetic-head slider 61 and an actuator 62 to a connection pad is performed (step S112).

[0097] Then, HGA which carried out in this way and was assembled is dipped in the solution of Fluorad FC-722 of for example, Sumitomo 3M, Inc. which is every round head and a fluorine system coating agent (step S113). Although it is a mere example, specifically, it is immersed into the solution which dissolved and obtained FC-722 (2%) by PF5060 (98%) of Sumitomo 3M, Inc. which is a solvent (DIP).

[0098] Subsequently, HGA is pulled up and dried from this solution (step S114). This desiccation is made by putting

in HGA in oven, for example, performing 120 degrees C and heat curing for about 30 minutes. Ultraviolet rays or infrared radiation may be irradiated and may carry out heat curing.

[0099] Since the whole HGA is covered by the covering film and all the PZT parts of an actuator will also be covered by this, degraining becomes that there is nothing. Since the fluorine system coating agent of FC-722 grade has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.

[0100] Moreover, since it is covered to the electrode terminal area of not only PZT but the actuator 62 and the head slider 61, improvement in dependability of connection can also be aimed at. In addition, since ABS of the head slider 61 is also covered by coincidence, contamination adhesion in ABS can also be prevented. Furthermore, since the covering film by the fluorine system coating agent is formed in this whole HGA after forming HGA through processes, such as adhesion, bond strength does not fall. And since coating of HGA can be performed only in a DIP, a production process can be simplified sharply.

[0101] If the whole HGA is attached to the thickness of the wrap covering film, without that it is 1.8nm or less filling the gap between each part material of HGA like the case of the operation gestalt of drawing 1 , from the point that thin layer coating can be performed, it is desirable and it is more desirable that it is 1.2nm or less.

[0102] In addition, without being limited to a fluorine system coating agent solution, as long as the solution into which HGA is made to dip is a low surface energy coating agent solution, it may be what kind of thing.

[0103] Since the other configurations and operation effectiveness of this operation gestalt are completely the same as that of the case of the operation gestalt of drawing 1 , explanation is omitted.

[0104] As mentioned above, although this invention was explained using HGA equipped with the actuator for minute positioning of a thin film magnetic-head component, this invention is not limited only to HGA equipped with such an actuator, and can be applied also to HGA equipped with the actuator for minute positioning of head components other than a thin film magnetic-head component (for example, an optical head component etc.).

[0105] This invention cannot be shown in instantiation, and not all the operation gestalten described above can show it restrictively, and can carry out this invention in other various deformation modes and modification modes. Therefore, the range of this invention is specified by only a claim and its equal range.

[0106]

[Effect of the Invention] Since the whole HGA is covered by the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent according to this invention as explained to the detail above and all the piezoelectric-material parts of an actuator will also be covered, degraining becomes that there is nothing. Since a low surface energy coating agent has ******, in the bottom of the environment of high temperature and high humidity, the migration by water absorption of a coating agent does not produce it.

[0107] Moreover, since it is covered to the electrode terminal area of not only piezoelectric material but an actuator and a head slider, improvement in dependability of connection can also be aimed at. In addition, since the surfacing side (ABS) of a head slider is also covered by coincidence, contamination adhesion in ABS can also be prevented.

[0108] Furthermore, since the covering film by the low surface energy coating agent which is for example, a fluorine system coating agent is formed in this whole HGA after forming HGA (i.e., since it has coated after adhesion), bond strength does not fall.

[0109] If HGA is dried after being immersed in the low surface energy coating agent solution which is for example, a fluorine system coating agent, and formation of the covering film is performed, since thin layer coating can be performed without filling the gap between each part material of HGA, actuation of an actuator is not checked. And since coating of HGA can be performed only in immersion, a production process can be simplified sharply.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] As 1 operation gestalt of this invention, it is the perspective view showing the configuration of the important section of a magnetic disk drive roughly.
[Drawing 2] It is the top view which looked at the whole head suspension assembly in the operation gestalt of drawing 1 from the slider side.
[Drawing 3] It is the decomposition perspective view showing the installation structure to FUREKUSHA of the actuator in the operation gestalt of drawing 1 , and a magnetic-head slider.
[Drawing 4] It is a flow chart for explaining 1 manufacture process of HGA in the operation gestalt of drawing 1 .
[Drawing 5] It is drawing showing the fall property of a stroke over the thickness of the covering film.
[Drawing 6] It is a perspective view showing the whole HGA in other operation gestalten of this invention.
[Drawing 7] It is the perspective view of the point of HGA in the operation gestalt of drawing 6 .
[Drawing 8] It is the perspective view which looked at the point of HGA in the operation gestalt of drawing 6 from the direction where drawing 3 differs.
[Drawing 9] It is the top view showing the structure of the actuator in the operation gestalt of drawing 6 .
[Drawing 10] It is a flow chart for explaining 1 manufacture process of HGA in the operation gestalt of drawing 6 .
[Description of Notations]
10 Magnetic Disk
11 13 Shaft
12 Assembly Carriage Equipment
14 Carriage
15 The Main Actuator
16 Drive Arm
17 HGA
20 60 Suspension
21 61 Magnetic-head slider
21a Predetermined section
21b Magnetic-head component
22 62 Actuator
22a Fixed part
22b Moving part
22c, 22d Displacement generating arm section
23 Load Beam
23a, 63a Installation section
26 66 FUREKUSHA
26a, 66a Tongue
27 67 Base plate
28 68 Wiring member
28a, 68a 1st wiring member
28b, 68b 2nd wiring member
29 69 Connection pad for magnetic-head components
30 70 Connection pad for external circuits
61a Terminal electrode
62a, 90 Base
62b, 62c Signal terminal electrode
62d, 62e Grand terminal electrode
63 1st Load Beam
64 2nd Load Beam
64a Lift tab
65 Hinge
66b Insulating layer
66c Separation section
71 Connection Pad for Actuators

91 92 Movable arm section
91a, 92a Arm member
91b, 92b Piezoelectric device
93 94 Slider fixing section

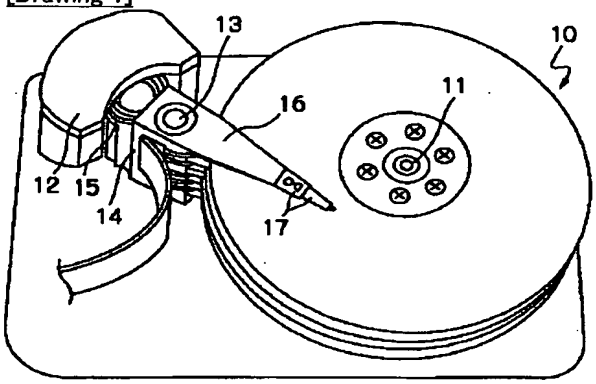
[Translation done.]

* NOTICES *

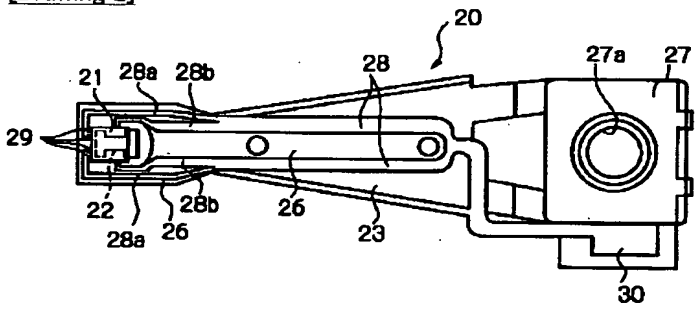
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

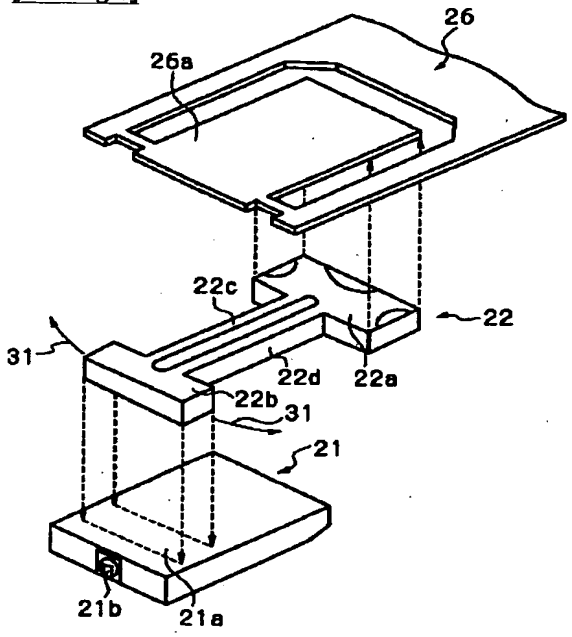
[Drawing 1]



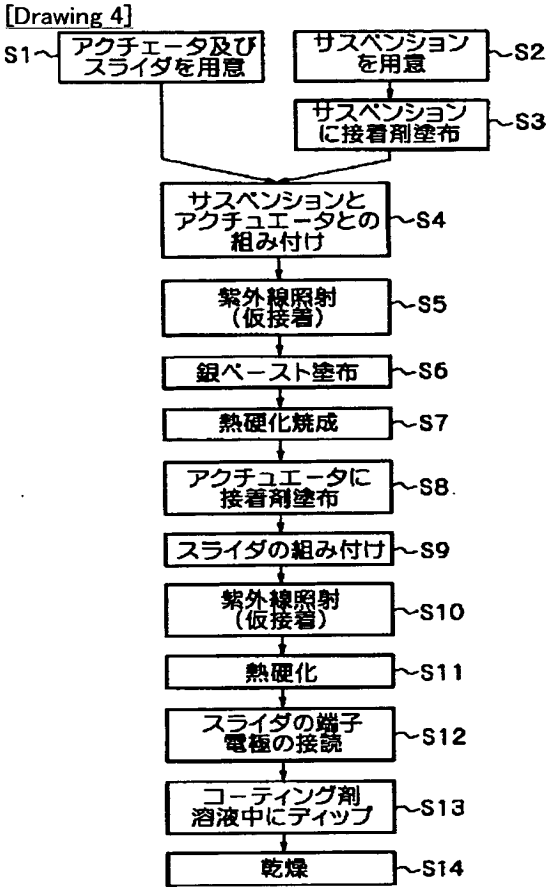
[Drawing 2]



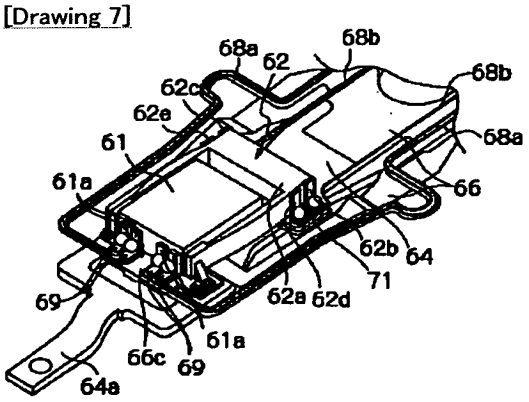
[Drawing 3]



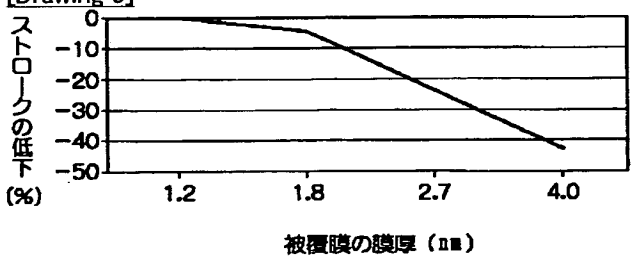
[Drawing 4]



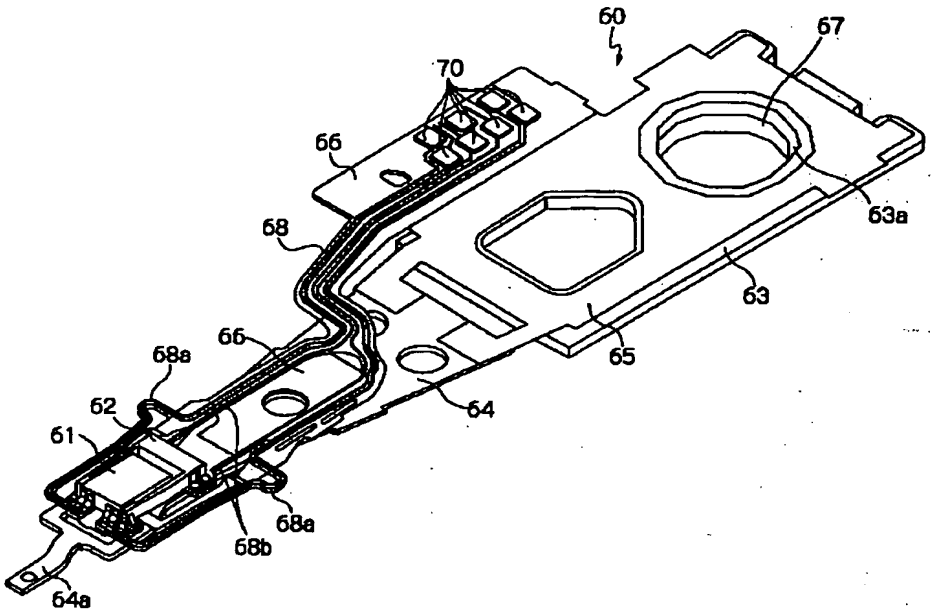
[Drawing 7]



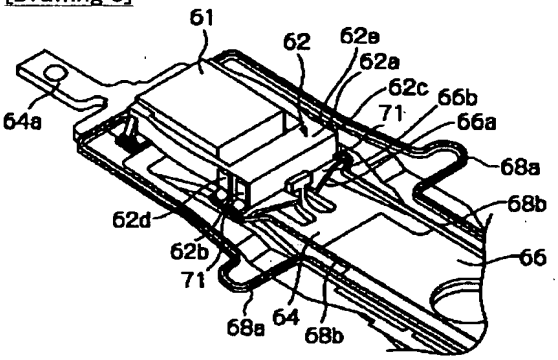
[Drawing 5]



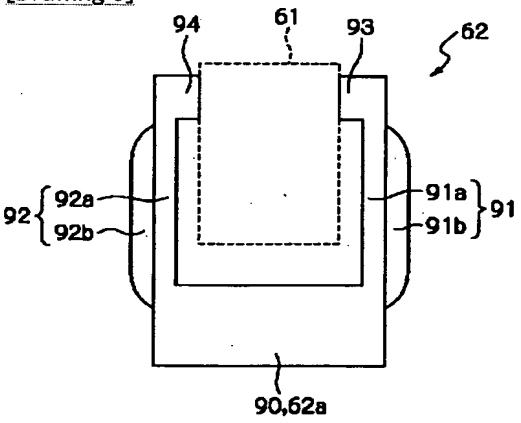
[Drawing 6]



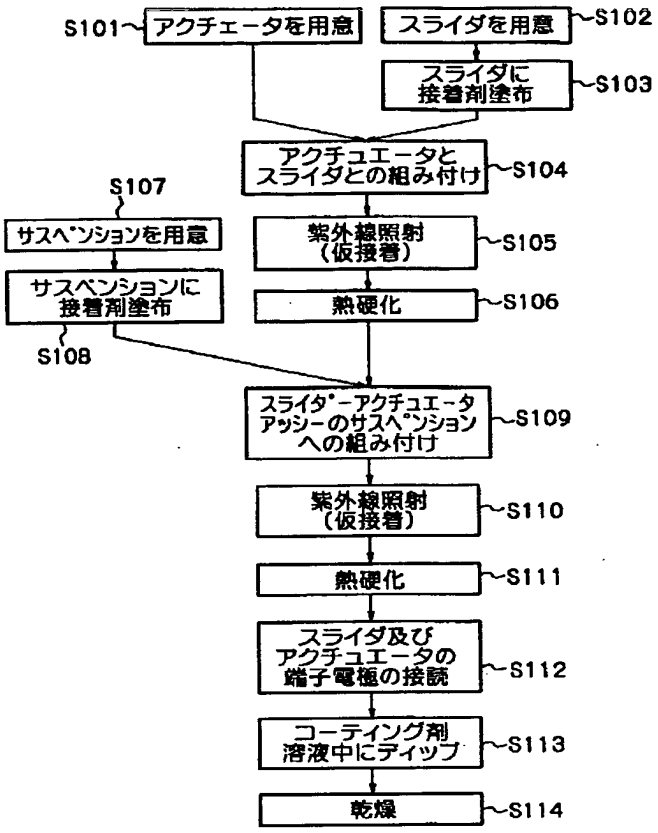
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

(19)日本国特許庁（ＪＰ） (12)公開特許公報（A） (11)特許出願公開番号
特開2002－74871
（P2002－74871A）
(43)公開日 平成14年３月15日(2002.3.15)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード(参考)
Ｇ１１Ｂ 21/10		Ｇ１１Ｂ 21/10	Ｎ	５Ｄ０４２
5/596		5/596		５Ｄ０５９
21/21		21/21	Ｃ	５Ｄ０９６

審査請求 未請求 請求項の数15 ＯＬ （全 13 頁）

(21)出願番号 特願2000－262561(P2000－262561)

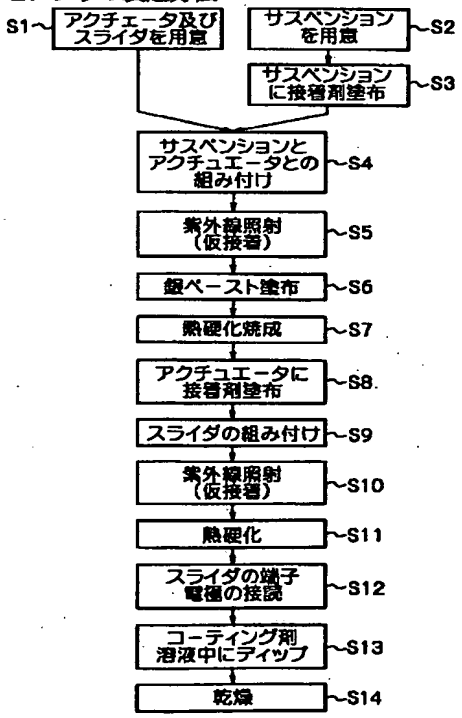
(22)出願日 平成12年８月31日(2000.8.31)

(71)出願人 000003067
ティーディーケイ株式会社
東京都中央区日本橋１丁目13番１号
(72)発明者 笠島 多聞
東京都中央区日本橋一丁目13番１号ティーディーケイ株式会社内
(72)発明者 白石 一雅
東京都中央区日本橋一丁目13番１号ティーディーケイ株式会社内
(74)代理人 100074930
弁理士 山本 恵一

Ｆターム(参考) 5D042 LA01 MA15
5D059 AA01 BA01 CA30 DA33 EA03
5D096 NN03 NN07

(54)【発明の名称】 微小位置決め用アクチュエータを備えたヘッドジンバルアセンブリ、該ヘッドジンバルアセンブリを備えたディスク装置及び該ヘッドジンバルアセンブリの製造方法

(57)【要約】
【課題】 圧電材料の脱粒を防止でき、アクチュエータの動作を阻害することなくしかも製造工程が簡易化でき、さらにアクチュエータの接着強度の低下がないる微小位置決め用アクチュエータを備えたＨＧＡ、このＨＧＡを備えたディスク装置及びこのＨＧＡの製造方法を提供する。
【解決手段】 少なくとも１つのヘッド素子を有するヘッドスライダをヘッド素子の微小位置決めを行う圧電現象を利用したアクチュエータに固着すると共にこのアクチュエータを支持機構に固着してＨＧＡを形成した後、このＨＧＡ全体に例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜を形成する。



の一つとして提案されているのが、従来のＶＣＭよりさらに磁気ヘッドスライダ側にもう１つのアクチュエータ機構を搭載し、ＶＣＭで追従しきれない微細な精密位置決めを、そのアクチュエータによって行なう技術である（例えば、特開平６－２５９９０５号公報、特開平６－３０９８２２号公報、特開平８－１８０６２３号公報参照）。

【０００５】

【発明が解決しようとする課題】圧電素子を利用したこの種のアクチュエータを用いた場合、圧電素子の粒子が脱落する（脱粒する）問題がある。即ち、圧電材料自体が脆弱な材料であるため、通常の使用状態であっても素子自身の欠けやクラックが発生する確率が高く、ましてや長期間の動作により結晶等の粒界が剥離して脱粒が発生し易くなる。磁気ディスク上に配置されるこの種のアクチュエータにおいては、いかなる脱粒をも許されるものではない。

【０００６】このような圧電材料は、脱粒が少なくなるように素材自身の性質を変化させることが難しい。このため、本出願人は、アクチュエータの表面にコーティングを施すことにより脱粒防止を図る技術を既に提案している（特願平１１－２９６５９７号）。

【０００７】一般に、アクチュエータを備えたＨＧＡにおいては、アクチュエータの動きを阻害しないために、磁気ヘッドスライダ及びアクチュエータ間、場合によってはアクチュエータ及びサスペンション間に間隙を置いて組み立てる必要がある。しかしながら、アクチュエータの表面にコーティングを施すと、このような間隙がなくなり、磁気ヘッドスライダ及びアクチュエータ間、及び／又はアクチュエータ及びサスペンション間で摩擦が生じてアクチュエータのストローク（変位）が低下し、スライダの動きが阻害されてしまう。

【０００８】さらに、コーティングを施すとそのコーティング面における接着強度を維持することが難しくなり、どうしても強度劣化が生じる。

【０００９】従って本発明は、従来技術の上述した問題点を解消するものであり、その目的は、圧電材料を用いた場合にも脱粒を確実に防止できる微小位置決め用アクチュエータを備えたＨＧＡ、このＨＧＡを備えたディスク装置及びこのＨＧＡの製造方法を提供することにある。

【００１０】本発明の他の目的は、アクチュエータの変位を阻害することなくしかも製造工程を簡易化できる微小位置決め用アクチュエータを備えたＨＧＡ、このＨＧＡを備えたディスク装置及びこのＨＧＡの製造方法を提供することにある。

【００１１】本発明のさらに他の目的は、アクチュエータの接着強度の低下がない微小位置決め用アクチュエータを備えたＨＧＡ、このＨＧＡを備えたディスク装置及びこのＨＧＡの製造方法を提供することにある。

【００１２】

【課題を解決するための手段】本発明によれば、少なくとも１つのヘッド素子を有するヘッドスライダと、このヘッドスライダが固着されておりヘッド素子の微小位置決めを行う圧電現象を利用したアクチュエータと、このアクチュエータが固着されておりアクチュエータを支持するための支持機構とを備えており、全体が例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜で覆われている微小位置決め用アクチュエータを備えたＨＧＡ及び少なくとも１つのＨＧＡを備えたディスク装置が提供される。

【００１３】さらに本発明によれば、少なくとも１つのヘッド素子を有するヘッドスライダを、ヘッド素子の微小位置決めを行う圧電現象を利用したアクチュエータを介して支持機構に固着してＨＧＡを形成した後、このＨＧＡ全体に例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜を形成するＨＧＡの製造方法が提供される。

【００１４】またさらに、本発明によれば、一方の端部に形成された固定部と他方の端部に形成された可動部とこれら固定部及び可動部を接続する変位発生アーム部とを有しており、ヘッド素子の微小位置決めを行う圧電現象を利用したアクチュエータを用意し、このアクチュエータの固定部を支持機構に固着し、少なくとも１つのヘッド素子を有するヘッドスライダを支持機構に固着したアクチュエータの可動部に固着してＨＧＡを形成した後、このＨＧＡ全体に例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜を形成するＨＧＡの製造方法が提供される。

【００１５】さらに、本発明によれば、駆動信号に従って変位可能な１対の可動アーム部を備えたヘッド素子微小位置決め用のアクチュエータを用意し、このアクチュエータの可動アーム部間に少なくとも１つのヘッド素子を有するヘッドスライダを挟設し、ヘッドスライダを取り付けたアクチュエータを支持機構に固着してＨＧＡを形成した後、このＨＧＡ全体に例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜を形成するＨＧＡの製造方法が提供される。

【００１６】ＨＧＡ全体が例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜で覆われているので、アクチュエータの圧電材料部分も全て被覆されることとなるから、脱粒が皆無となる。低表面エネルギーコーティング剤は、揮水性があるため、高温度、高湿度の環境下においてもコーティング剤の吸水によるマイグレーションが生じない。

【００１７】また、圧電材料のみならずアクチュエータ及びヘッドスライダの電極端子部まで被覆されるので、接続の信頼性向上をも図ることができる。加えて、ヘッドスライダの浮上面（ＡＢＳ）も同時に被覆されるため、ＡＢＳへのコンタミネーション付着をも防止でき

【００３４】フレクシャ２６上には、積層薄膜パターンによる複数のリード導体を含む可撓性の配線部材２８が形成されている。即ち、配線部材２８は、フレクシブルプリント回路（Ｆｌｅｘｉｂｌｅ　Ｐｒｉｎｔ　Ｃｉｒｃｕｉｔ、ＦＰＣ）のごとく金属薄板上にプリント基板を作成するのと同じ公知のパターニング方法で形成されている。例えば、厚さ約５μｍのポリイミド等の樹脂材料による第１の絶縁性材料層、パターン化された厚さ約４μｍのＣｕ層（リード導体層）及び厚さ約５μｍのポリイミド等の樹脂材料による第２の絶縁性材料層をこの順序でフレクシャ２６側から順次積層することによって形成される。ただし、磁気ヘッド素子及び外部回路と接続するための接続パッドの部分は、Ｃｕ層上にＡｕ層が積層形成されており、その上に絶縁性材料層は形成されていない。

【００３５】本実施形態においてこの配線部材２８は、磁気ヘッド素子に接続される片側２本、両側で計４本のリード導体を含む第１の配線部材２８ａと、アクチュエータ２２に接続される片側２本、両側で計４本のリード導体を含む第２の配線部材２８ｂとから構成されている。

【００３６】第１の配線部材２８ａのリード導体の一端は、フレクシャ２６の先端部に設けられた磁気ヘッド素子用接続パッド２９に接続されている。接続パッド２９は、磁気ヘッドスライダ２１の端子電極に金ボンディング、ワイヤボンディング又はステッチボンディング等により接続されている。第１の配線部材２８ａのリード導体の他端は外部回路と接続するための外部回路用接続パッド３０に接続されている。

【００３７】第２の配線部材２８ｂのリード導体の一端は、フレクシャ２６の舌部２６ａに形成されたアクチュエータ用接続パッド（図示なし）に接続されており、この接続パッドはアクチュエータ２２の端子電極に接続されている。第２の配線部材２８ｂのリード導体の他端は外部回路と接続するための外部回路用接続パッド３０に接続されている。

【００３８】アクチュエータ２２は、固定部２２ａ及び可動部２２ｂを有し、さらに、これらを接続する２本の棒状の変位発生アーム部２２ｃ及び２２ｄを有する。変位発生アーム部２２ｃ及び２２ｄには、両側に電極層が存在する圧電・電歪材料層が少なくとも１層設けられており、電極層に電圧を印加することにより伸縮を発生する構成となっている。圧電・電歪材料層は、逆圧電効果又は電歪効果により伸縮する圧電・電歪材料からなる。固定部２２ａには、上述の電極層に接続されている３つの端子電極が形成されている。

【００３９】図３に示すように、フレクシャ２６の舌部２６ａには、アクチュエータ２２の固定部２２ａにおける上面が接着剤によって接着されている。アクチュエータ２２の可動部２２ｂは、磁気ヘッドスライダ２１の後端側（磁気ヘッド素子２１ｂの形成端側）の所定部２２ａに固着面が接着剤により接着されることによって固着されている。

【００４０】このように、変位発生アーム部２２ｃ及び２２ｄの一端は固定部２２ａを介してフレクシャ２６に連結され、変位発生アーム部２２ｃ及び２２ｄの他端は可動部２２ｂを介してスライダ２１に連結されている。従って、変位発生アーム部２２ｃ及び２２ｄの伸縮によりスライダ２１が変位して、磁気ヘッド素子が磁気ディスクの記録トラックと交差するように弧状に変位する。

【００４１】変位発生アーム部２２ｃ及び２２ｄにおける圧電・電歪材料層がＰＺＴ等のいわゆる圧電材料から構成されている場合、この圧電・電歪材料層には、通常、変位性能向上のための分極処理が施されている。この分極処理による分極方向は、アクチュエータ２２の厚さ方向である。電極層に電圧を印加したときの電界の向きが分極方向と一致する場合、両電極間の圧電・電歪材料層はその厚さ方向に伸長（圧電縦効果）し、その面内方向では収縮（圧電横効果）する。一方、電界の向きが分極方向と逆である場合、圧電・電歪材料層はその厚さ方向に収縮（圧電縦効果）し、その面内方向では伸長（圧電横効果）する。そして、一方の変位発生アーム部と他方の変位発生アーム部とに、収縮を生じさせる電圧を交互に印加すると、一方の変位発生アーム部の長さと他方の変位発生アーム部の長さとの比率が変化し、これによって両変位発生アーム部はアクチュエータ２２の面内において同方向に撓む。この撓みによって、固定部２２ａに対し可動部２２ｂが、電圧無印加時の位置を中央として図３の矢印３１の方向に揺動することになる。この揺動は、可動部２２ｂが、変位発生アーム部２２ｃ及び２２ｄの伸縮方向に対しほぼ直交する方向に弧状の軌跡を描く変位であり、揺動方向はアクチュエータの面内に存在する。従って、磁気ヘッド素子も弧状の軌跡を描いて揺動することになる。このとき、電圧と分極とは向きが同じなので、分極減衰のおそれがなく、好ましい。なお、両変位発生アーム部に交互に印加する電圧が変位発生アーム部を伸長させるものであっても、同様な揺動が生じる。

【００４２】アクチュエータ２２としては、両変位発生アーム部に、互いに逆の変位が生じるような電圧を同時に印加してもよい。即ち、一方の変位発生アーム部と他方の変位発生アーム部とに、一方が伸長したとき他方が収縮し、一方が収縮したとき他方が伸長するような交番電圧を同時に印加してもよい。このときの可動部２２ｂの揺動は、電圧無印加時の位置を中央とするものとなる。この場合、駆動電圧を同じとしたときの揺動の振幅は、電圧を交互に印加する場合の約２倍となる。ただし、この場合、揺動の一方の側では変位発生アーム部を伸長させることになり、このときの駆動電圧は分極の向きと逆となる。このため、印加電圧が高い場合や継続的

ら引き上げる時の速度（一般に、引き上げ速度が速いと膜厚は厚くなり、遅いと薄くなる）、ディップ温度等によって制御可能であるが、あまり厚くなるとアクチュエータ２２の動きが阻害されてストローク（変位）が低下してしまう。図５は被覆膜の膜厚に対するストロークの低下特性を表す図である。同図から分かるように、被覆膜の膜厚は、１．８ｎｍ以下であることがＨＧＡの各部材間の間隙を埋めることなく薄膜コーティングが行える点から好ましく、１．２ｎｍ以下であることがより好ましい。

【００６１】なお、ＨＧＡをディップさせる溶液は、フッ素系コーティング剤溶液に限定されることなく、低表面エネルギーコーティング剤溶液であればいかなるものであってもよい。

【００６２】図６は本発明の他の実施形態におけるＨＧＡ全体を表す斜視図であり、図７及び図８は図６の実施形態におけるＨＧＡの先端部を互いに異なる方向から見た斜視図である。なお、本実施形態は、アクチュエータとして、スライダ挟設型のものを用いた場合である。

【００６３】図６～図８に示すように、本実施形態におけるＨＧＡは、サスペンション６０の先端部に、磁気ヘッド素子を有する磁気ヘッドスライダ６１の側面を挟持している精密位置決めを行うためのアクチュエータ６２を固着して構成される。

【００６４】図１に示す主アクチュエータ１５はＨＧＡ１７を取り付けた駆動アーム１６を変位させてアセンブリ全体を動かすために設けられており、このアクチュエータ６２はそのような主アクチュエータ１５では駆動できない微細な変位を可能にするために設けられている。

【００６５】サスペンション６０は、図６～図８に示すように、第１及び第２のロードビーム６３及び６４と、これら第１及び第２のロードビーム６３及び６４を互いに連結する弾性を有するヒンジ６５と、第２のロードビーム６４及びヒンジ６５上に固着支持された弾性を有するフレクシャ６６と、第１のロードビーム６３の取り付け部６３ａに設けられた円形のベースプレート６７とから主として構成されている。

【００６６】フレクシャ６６は、第２のロードビーム６４に設けられたディンプル（図示なし）に押圧される軟らかい舌部６６ａを一方の端部に有しており、この舌部６６ａ上には、ポリイミド等による絶縁層６６ｂを介してアクチュエータ６２の基部６２ａが固着されている。このフレクシャ６６は、この舌部６６ａでアクチュエータ６２を介して磁気ヘッドスライダ６１を柔軟に支えるような弾性を持っている。フレクシャ６６は、本実施形態では、厚さ約２０μｍのステンレス鋼板（例えばＳＵＳ３０４ＴＡ）によって構成されている。なお、フレクシャ６６と第２のロードビーム６４及びヒンジ６５との固着は、複数の溶接点によるピンポイント固着によってなされている。

【００６７】ヒンジ６５は、第２のロードビーム６４にアクチュエータ６２を介してスライダ６１を磁気ディスク方向に押えつける力を与えるための弾性を有している。このヒンジ６５は、本実施形態では、厚さ約４０μｍのステンレス鋼板によって構成されている。

【００６８】第１のロードビーム６３は、本実施形態では、約１００μｍ厚のステンレス鋼板で構成されており、ヒンジ６５をその全面に渡って支持している。ただし、ロードビーム６３とヒンジ６５との固着は、複数の溶接点によるピンポイント固着によってなされている。また、第２のロードビーム６４も、本実施形態では、約１００μｍ厚のステンレス鋼板で構成されており、ヒンジ６５にその端部において固着されている。ただし、ロードビーム６４とヒンジ６５との固着も、複数の溶接点によるピンポイント固着によってなされている。なお、この第２のロードビーム６４の先端には、非動作時にＨＧＡを磁気ディスク表面から離しておくためのリフトタブ６４ａが設けられている。

【００６９】ベースプレート６７は、本実施形態では、約１５０μｍ厚のステンレス鋼又は鉄で構成されており、第１のロードビーム６３の基部の取り付け部６３ａに溶接によって固着されている。このベースプレート６７が駆動アーム１６（図１）に取り付けられる。

【００７０】フレクシャ６６上には、積層薄膜パターンによる複数のリード導体を含む可撓性の配線部材６８が形成又は載置されている。配線部材６８は、ＦＰＣのごとく金属薄板上にプリント基板を作成するのと同じ公知のパターニング方法で形成されている。この配線部材６８は、例えば、厚さ約５μｍのポリイミド等の樹脂材料による第１の絶縁性材料層、パターン化された厚さ約４μｍのＣｕ層（リード導体層）及び厚さ約５μｍのポリイミド等の樹脂材料による第２の絶縁性材料層をこの順序でフレクシャ６６側から順次積層することによって形成される。ただし、磁気ヘッド素子、アクチュエータ及び外部回路と接続するための接続パッドの部分は、Ｃｕ層上にＡｕ層が積層形成されており、その上に絶縁性材料層は形成されていない。

【００７１】本実施形態においてこの配線部材６８は、磁気ヘッド素子に接続される片側２本、両側で計４本のリード導体を含む第１の配線部材６８ａと、アクチュエータ６２に接続される片側１本、両側で計２本のリード導体を含む第２の配線部材６８ｂとから構成されている。

【００７２】第１の配線部材６８ａのリード導体の一端は、フレクシャ６６の先端部において、このフレクシャ６６から切り離されており自由運動できる分離部６６ｃ上に設けられた磁気ヘッド素子用接続パッド６９に接続されている。接続パッド６９は、磁気ヘッドスライダ６１の端子電極６１ａに金ボンディング、ワイヤボンディング又はステッチボンディング等により接続されてい

a）（Ｚｒ，Ｔｉ）O_3］、チタン酸バリウム（ＢａＴｉO_3）等のセラミックス圧電・電歪材料が好ましい。

【００８５】本実施形態において重要なポイントは、図には示されていないが、ＨＧＡ全体が例えばフッ素系コーティング剤である低表面エネルギーコーティング剤による被覆膜で覆われていることである。フッ素系コーティング剤としては、例えば、住友スリーエム株式会社のフロラードＦＣ－７２２が用いられる。

【００８６】このように、ＨＧＡ全体を被覆膜で覆うことにより、アクチュエータ６２のＰＺＴ部分も全て被覆されることとなるから、脱粒が皆無となる。ＦＣ－７２２等のフッ素系コーティング剤は、撥水性があるため、高温度、高湿度の環境下においてもコーティング剤の吸水によるマイグレーションが生じない。

【００８７】また、ＰＺＴのみならずアクチュエータ６２及びヘッドスライダ６１の電極端子部まで被覆されるので、接続の信頼性向上をも図ることができる。加えて、ヘッドスライダ６１のＡＢＳも同時に被覆されるため、ＡＢＳへのコンタミネーション付着をも防止できる。

【００８８】本発明のＨＧＡにおけるサスペンションの構造は、以上述べた構造に限定されるものではないことは明らかである。なお、図示されていないが、サスペンション６０の途中にヘッド駆動用ＩＣチップを装着してもよい。

【００８９】図１０は、本実施形態におけるＨＧＡの一製造過程を説明するためのフローチャートである。

【００９０】まず、前述のごときアクチュエータ６２を用意する（ステップＳ１０１）。

【００９１】磁気ヘッドスライダ６１側においては、用意された磁気ヘッドスライダ６１（ステップＳ１０２）の両側面に接着剤を塗布する（ステップＳ１０３）。

【００９２】次いで、この磁気ヘッドスライダ６１を、同じく平面板上に載置されているアクチュエータ６２の可動アーム部９１及び９２間に挿入し（ステップＳ１０４）、その後、紫外線を照射して接着剤をある程度硬化させ、仮接着を行う（ステップＳ１０５）。なお、アクチュエータ６２の可動アーム部９１及び９２におけるスライダ固着部９３及び９４間の間隔が磁気ヘッドスライダ６１の幅よりやや小さくなるように設定しておけば、可動アーム部９１及び９２の把持力で磁気ヘッドスライダ６１は、ホルダ等を用いることなく仮固定される。

【００９３】次いで、加熱して接着剤を完全に熱硬化させる（ステップＳ１０６）。これにより、磁気ヘッドスライダ６１とアクチュエータ６２との複合体であるスライダーアクチュエータアッシーが形成される。

【００９４】一方、前述したようなサスペンションを用意し（ステップＳ１０７）、そのフレクシャ６６の舌部６６ａにおける絶縁層６６ｂ上とフレクシャ６６の分離部６６ｃ上に接着剤をそれぞれ塗布しておき（ステップＳ１０８）、スライダーアクチュエータアッシーをサスペンション上に接着固定する。これにより、スライダーアクチュエータアッシーのサスペンションへの組み付けが行われてＨＧＡが形成される（ステップＳ１０９）。

【００９５】次いで、紫外線を照射して接着剤をある程度硬化させ、仮接着を行った（ステップＳ１１０）後、さらに、加熱して接着剤を完全に熱硬化させる（ステップＳ１１１）。

【００９６】次いで、磁気ヘッドスライダ６１及びアクチュエータ６２の端子電極を接続パッドに接続する処理を行う（ステップＳ１１２）。

【００９７】その後、このようにして組み立てたＨＧＡを丸ごと、フッ素系コーティング剤である例えば、住友スリーエム株式会社のフロラードＦＣ－７２２の溶液内にディップする（ステップＳ１１３）。具体的には、単なる一例であるが、ＦＣ－７２２（２％）を、溶剤である住友スリーエム株式会社のＰＦ５０６０（９８％）で溶解して得た溶液中に浸漬（ディップ）する。

【００９８】次いで、ＨＧＡをこの溶液から引き上げて乾燥させる（ステップＳ１１４）。この乾燥は、オーブン内にＨＧＡを入れ、例えば１２０℃、約３０分の熱硬化を行うことによりなされる。紫外線又は赤外線を照射して熱硬化させてもよい。

【００９９】これにより、ＨＧＡ全体が被覆膜で覆われているので、アクチュエータのＰＺＴ部分も全て被覆されることとなるから、脱粒が皆無となる。ＦＣ－７２２等のフッ素系コーティング剤は、撥水性があるため、高温度、高湿度の環境下においてもコーティング剤の吸水によるマイグレーションが生じない。

【０１００】また、ＰＺＴのみならずアクチュエータ６２及びヘッドスライダ６１の電極端子部まで被覆されるので、接続の信頼性向上をも図ることができる。加えて、ヘッドスライダ６１のＡＢＳも同時に被覆されるため、ＡＢＳへのコンタミネーション付着をも防止できる。さらに、接着等の工程を経てＨＧＡを形成した後、このＨＧＡ全体にフッ素系コーティング剤による被覆膜を形成しているので、接着強度が低下することは全くない。しかも、ディップのみでＨＧＡのコーティングができるので、製造工程を大幅に簡易化できる。

【０１０１】ＨＧＡ全体を覆う被覆膜の膜厚に付いては、図１の実施形態の場合と同様に、１．８ｎｍ以下であることがＨＧＡの各部材間の間隙を埋めることなく薄膜コーティングが行える点から好ましく、１．２ｎｍ以下であることがより好ましい。

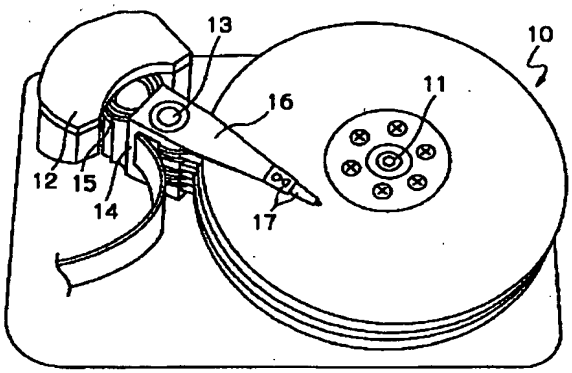
【０１０２】なお、ＨＧＡをディップさせる溶液は、フッ素系コーティング剤溶液に限定されることなく、低表面エネルギーコーティング剤溶液であればいかなるものであってもよい。

【０１０３】本実施形態のその他の構成及び作用効果は、図１の実施形態の場合と全く同様であるため、説明

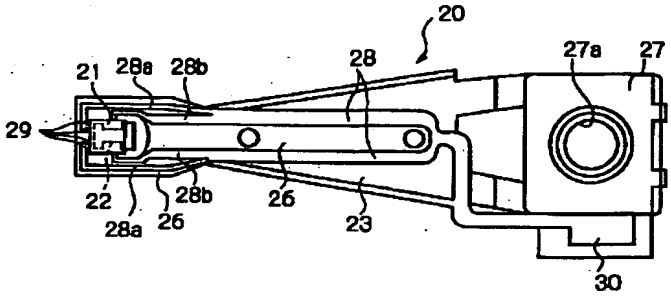
９１ａ、９２ａ　アーム部材
９１ｂ、９２ｂ　圧電素子

９３、９４　スライダ固着部

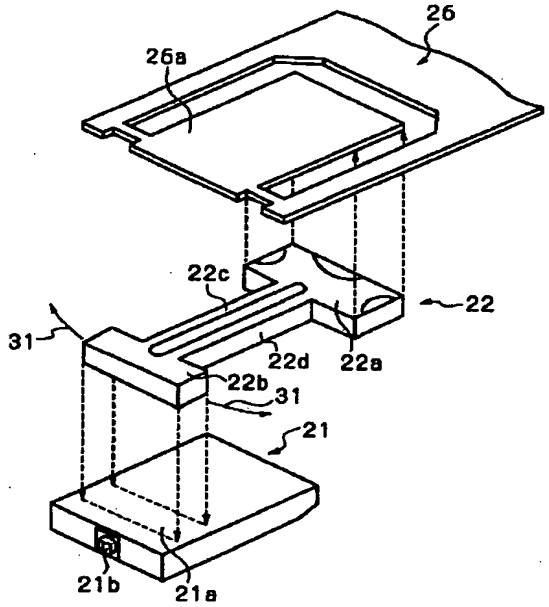
【図１】



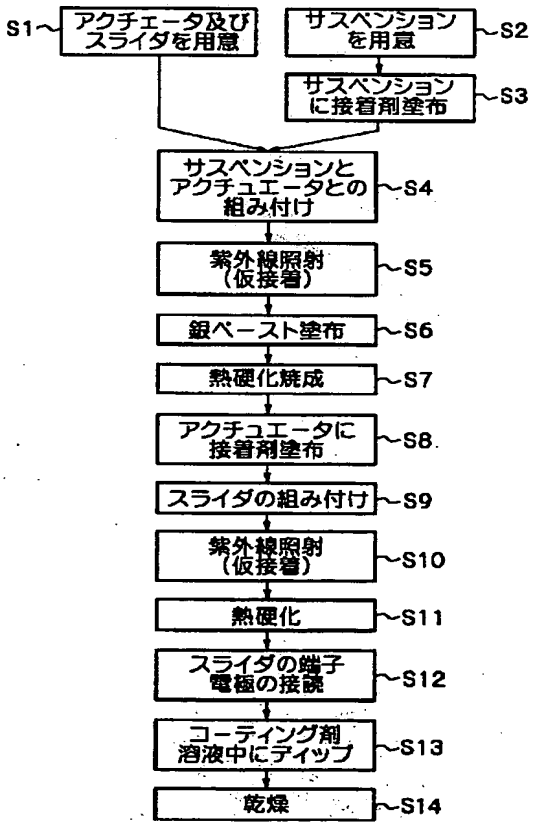
【図２】



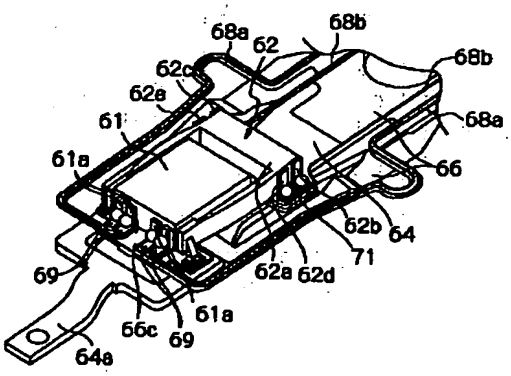
【図３】



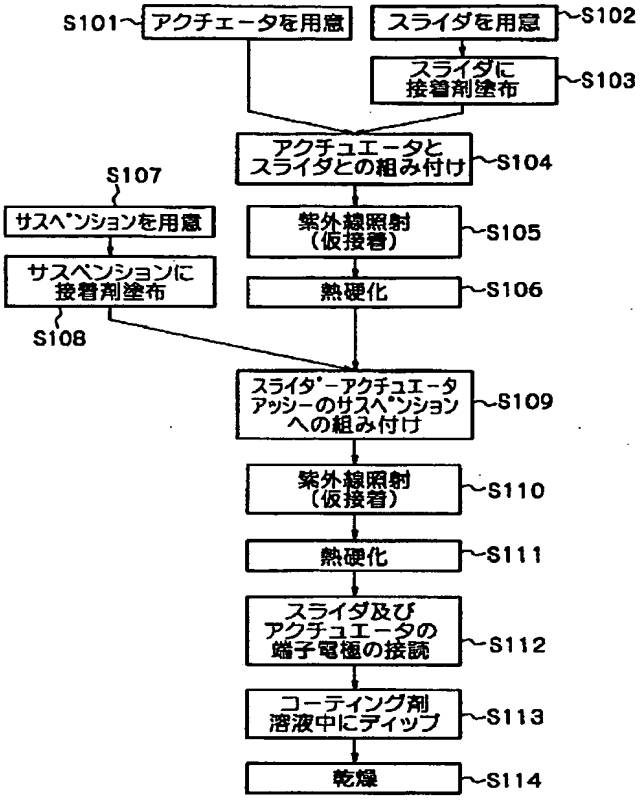
【図４】



【図７】



【図１０】


S101
アクチュエータを用意
スライダを用意
S102
スライダに
接着剤塗布
S103
アクチュエータと
スライダとの組み付け
S104
S107
サスペンションを用意
紫外線照射
（仮接着）
S105
サスペンションに
接着剤塗布
熱硬化
S106
S108
スライダ－アクチュエータ
アッシーのサスペンション
への組み付け
S109
紫外線照射
（仮接着）
S110
熱硬化
S111
スライダ及び
アクチュエータの
端子電極の接続
S112
コーティング剤
溶液中にディップ
S113
乾燥
S114